

### Amendments of the Claims:

A detailed listing of all claims in the application is presented below. This listing of claims will replace all prior versions, and listings, of claims in the application. All claims being currently amended are submitted with markings to indicate the changes that have been made relative to immediate prior version of the claims. The changes in any amended claim are being shown by ~~striketrough~~ (for deleted matter) or underlined (for added matter).

1 - 12. (Cancelled)

13. (Currently Amended) An ultra miniature integrated cardiac pacemaker implanted into a heart of a patient, comprising:

- a) a control unit that outputs at least one control signal;
- b) a heart stimulating means that responds to the control signal and electrically stimulates heart tissue;
- c) an electrocardiographic information detecting means that detects a plurality of electrocardiographic information and outputs the electrocardiographic information to the control unit;
- d) a transmitting means that modulates the electrocardiographic information and control signal and sends the modulated electrocardiographic information and the modulated control signal outside of the ultra miniature integrated cardiac pacemaker via a plurality of carrier waves to at least one other ultra miniature integrated cardiac pacemaker implanted into the heart of the patient;
- e) a receiving means that demodulates information transmitted from outside of the ultra miniature integrated cardiac pacemaker; and

f) a power unit that supplies the driving power;

wherein the ultra miniature integrated cardiac pacemaker requires no chest incision, and can be implanted into a heart by attaching the ultra miniature integrated cardiac pacemaker to a tip of a catheter and extracting the catheter after implantation;

wherein the ultra miniature integrated cardiac pacemaker is designed such that information sent from the at least one other ultra miniature integrated cardiac pacemaker ~~outside~~ is input into the control unit after the information is demodulated by the receiving means;

wherein the control unit of the ultra miniature integrated cardiac pacemaker outputs the control signal based on information selected from the group consisting of a) information sent from ~~outside the at least one other ultra miniature integrated cardiac pacemaker~~; b) electrocardiographic information; and c) a combination of a) and b); ~~information sent from outside and electrocardiographic information, wherein the information sent from outside includes information sent from other pacemakers when a plurality of pacemakers are implanted into a heart; and~~

wherein the control unit of the ultra miniature integrated cardiac pacemaker outputs the control signal based on the information sent from the at least one other ultra miniature integrated cardiac pacemaker implanted into the heart to pace the heart and mimic a natural physiological state of the heart;

wherein the control unit includes a stimulation timing determining means that determines ~~decides~~ the timing of stimulation to generate

control signals, and a stimulation timing changing means that changes the timing of stimulation to generate control signals;

wherein the control unit changes the stimulation timing when certain conditions are fulfilled;

wherein the power unit is a biological fuel cell that extracts electrons from oxidative reactions of biological fuels;

wherein the biological fuel cell is composed of an anode and a cathode;

wherein the anode comprises an anode electrode and an immobile layer formed on a surface of the anode electrode by immobilization of mediators and oxidative enzymes for biological fuels, wherein said immobile layer prevents oxygen existing in a biological body from contacting said anode electrode;

wherein the cathode comprises a cathode electrode and a coating material formed on a surface of the cathode electrode, wherein the cathode electrode is composed of ~~requires~~ a catalyst to enhance a reaction involving reduction of oxygen, and wherein said coating material is capable of preventing permeation of reactive substances other than oxygen and allowing permeation of oxygen and hydrogen ions;

wherein the biological fuel cell uses an electrolyte solution selected from the group consisting of blood; body fluid; and blood and body fluid, and utilizes biological fuels and oxygen in the electrolyte solution without the need for a container to contain the electrolyte solution or a metabolic product; and

wherein said anode and said cathode are adapted to contact the electrolyte solution.

14-18. (Cancelled)

19. (Currently Amended) An ultra miniature integrated cardiac pacemaker implanted into a heart of a patient, comprising:

- a) a control unit that outputs at least one control signal;
- b) a heart stimulating means that responds to the control signal and electrically stimulates heart tissue;
- c) an electrocardiographic information detecting means that detects a plurality of electrocardiographic information and outputs the electrocardiographic information to the control unit;
- d) a transmitting means that modulates the electrocardiographic information and control signal and sends the modulated electrocardiographic information and the modulated control signal via a plurality of carrier waves to at least one other ultra miniature integrated cardiac pacemaker implanted into the heart of the patient~~outside~~;
- e) a receiving means that demodulates information transmitted from the at least one other ultra miniature integrated cardiac pacemaker ~~outside~~; and
- f) a power unit that supplies the driving power;

wherein the ultra miniature integrated cardiac pacemaker requires no chest incision, and can be implanted into a heart by attaching the ultra miniature integrated cardiac pacemaker to a tip of a catheter and extracting the catheter after implantation;

wherein the ultra miniature integrated cardiac pacemaker is designed such that the information sent from the at least one other ultra miniature integrated cardiac pacemaker~~other pacemakers~~ ~~implanted into the heart~~ is input into the control unit after the information is demodulated by the receiving means;

wherein the control unit of the ultra miniature integrated cardiac pacemaker outputs the control signal based on the information comprising information sent from the at least one other ultra miniature integrated cardiac pacemakers implanted into the heart to pace the heart and mimic a natural physiological state of the heart;

wherein the control unit includes a stimulation timing determining means that determines~~decides~~ the timing of stimulation to generate control signals, and a stimulation timing changing means that changes the timing of stimulation to generate control signals;

wherein the control unit changes the stimulation timing when certain conditions are fulfilled;

wherein the power unit is a biological fuel cell that extracts electrons from oxidative reactions of biological fuels;

wherein the biological fuel cell is composed of an anode and a cathode;

wherein the anode comprises an anode electrode and an immobile layer formed on a surface of the anode electrode by immobilization of mediators and oxidative enzymes for biological fuels, wherein said immobile layer prevents oxygen existing in a biological body from contacting said anode electrode;

wherein the cathode comprises a cathode electrode and a coating material formed on a surface of the cathode electrode, wherein the cathode electrode is composed of a catalyst to enhance a reaction involving reduction of oxygen, and wherein said coating material is capable of preventing permeation of reactive substances other than oxygen and allowing permeation of oxygen and hydrogen ions;

wherein the biological fuel cell uses an electrolyte solution selected from the group consisting of blood; body fluid; and blood and body fluid, and utilizes biological fuels and oxygen in the electrolyte solution without the need for a container to contain the electrolyte solution or a metabolic product; and

wherein said anode and said cathode are adapted to contact the electrolyte solution.

20. (Previously Presented) The pacemaker of claim 19, wherein the control unit outputs the control signal based on additional information comprising electrocardiographic information.
21. (New) The ultra miniature integrated cardiac pacemaker of claim 13, wherein the ultra miniature integrated cardiac pacemaker is part of a distributed cardiac pacing system further comprising the at least one other ultra miniature integrated cardiac pacemaker implanted into the heart.
22. (New) The ultra miniature integrated cardiac pacemaker of claim 21, wherein the at least one other ultra miniature integrated cardiac pacemaker comprises a plurality of ultra miniature integrated cardiac pacemakers.
23. (New) The ultra miniature integrated cardiac pacemaker of claim 13, wherein the ultra miniature integrated cardiac pacemaker is placed on an atrium or a ventricle of the heart of the patient.

24. (New) The ultra miniature integrated cardiac pacemaker of claim 13, wherein the at least one other ultra miniature integrated cardiac pacemaker is placed on an atrium or a ventricle of the heart of the patient.
25. (New) The ultra miniature integrated cardiac pacemaker of claim 19, wherein the ultra miniature integrated cardiac pacemaker is part of a distributed cardiac pacing system further comprising the at least one other ultra miniature integrated cardiac pacemaker implanted into the heart.
26. (New) The ultra miniature integrated cardiac pacemaker of claim 25, wherein the at least one other ultra miniature integrated cardiac pacemaker comprises a plurality of ultra miniature integrated cardiac pacemakers.
27. (New) The ultra miniature integrated cardiac pacemaker of claim 19, wherein the ultra miniature integrated cardiac pacemaker is placed on an atrium or a ventricle of the heart of the patient.
28. (New) The ultra miniature integrated cardiac pacemaker of claim 19, wherein the at least one other ultra miniature integrated cardiac pacemaker is placed on an atrium or a ventricle of the heart of the patient.
29. (New) A method of pacing a heart using a cardiac pacing system comprising a first ultra miniature integrated cardiac pacemaker implanted into the heart of a patient, comprising the steps of:
- a) outputting at least one control signal using a control unit of the first ultra miniature integrated cardiac pacemaker;
  - b) responding to the control signal and electrically stimulating heart tissue;
  - c) detecting a plurality of electrocardiographic information;

- d) outputting the electrocardiographic information to a control unit of the first ultra miniature integrated cardiac pacemaker;
- e) modulating the electrocardiographic information and the control signal;
- f) sending the modulated electrocardiographic information and the modulated control signal outside via a plurality of carrier waves to at least one second ultra miniature integrated cardiac pacemaker implanted into the heart of the patient;
- g) demodulating the information sent from the at least one second ultra miniature integrated cardiac pacemaker;
- h) inputting the information sent from the second ultra miniature integrated cardiac pacemaker into the control unit after step g);

wherein the control unit of the first ultra miniature integrated cardiac pacemaker outputs the control signal based on information selected from the group consisting of a) information sent from the second ultra miniature integrated cardiac pacemaker; b) electrocardiographic information; and c) a combination of a) and b);

wherein the control unit of the ultra miniature integrated cardiac pacemaker outputs the control signal based on the information from the second ultra miniature integrated cardiac pacemakers to pace the heart and mimic a natural physiological state of the heart;

wherein the control unit determines the timing of stimulation to generate control signals, and changes the timing of stimulation to generate control signals;

wherein the control unit changes the stimulation timing when certain conditions are fulfilled;



wherein the first ultra miniature integrated cardiac pacemaker comprises  
a biological fuel cell that extracts electrons from oxidative reactions  
of biological fuels;

wherein the biological fuel cell is composed of an anode and a cathode;

wherein the anode comprises an anode electrode and an immobile layer  
formed on a surface of the anode electrode by immobilization of  
mediators and oxidative enzymes for biological fuels, wherein said  
immobile layer prevents oxygen existing in a biological body from  
contacting said anode electrode;

wherein the cathode comprises a cathode electrode and a coating material  
formed on a surface of the cathode electrode, wherein the cathode  
electrode is composed of a catalyst to enhance a reaction involving  
reduction of oxygen, and wherein said coating material is capable  
of preventing permeation of reactive substances other than oxygen  
and allowing permeation of oxygen and hydrogen ions;

wherein the biological fuel cell uses an electrolyte solution selected from  
the group consisting of blood; body fluid; and blood and body  
fluid, and utilizes biological fuels and oxygen in the electrolyte  
solution without the need for a container to contain the electrolyte  
solution or a metabolic product; and

wherein said anode and said cathode are adapted to contact the electrolyte  
solution.

30. (New) The method of claim 29, further comprising the step of supplying driving  
power to the first ultra miniature integrated cardiac pacemaker using the  
biological fuel cell.

31. (New) The method of claim 29, further comprising the step of implanting the ultra miniature integrated cardiac pacemaker into the heart by attaching the pacemaker to a tip of a catheter and extracting the catheter after implantation.
32. (New) The method of claim 31, wherein the step of implanting requires no chest incision.